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## REMARKS

I. Status of the Claims

Claims 1-18 are pending in this application. Claims 17 and 18 are cancelled in this response. Claims 1-16 remain for consideration.

II. Response to the Section 102 Rejection

Applicants have cancelled claims 17 and 18 which Examiner rejected under 35 U.S.C. § 102(b) as being anticipated by Yen et al. (U.S. Pat. No. 6,402,939).

III. Response to the Section 103(a) Rejection over Louis in view of Johnstone and Sorgenti

Applicants traverse the rejection of claims 1, 2, 5 and 6 under 35 U.S.C. § 103(a) as unpatentable over Louis et al. (WO 03/093203) in view of Johnstone (U.S. Pat. No. 2,593,761) and Sorgenti (U.S. Pat. No. 3,816,301), and they respectfully ask the Examiner to reconsider and withdraw the rejection in view of the following remarks.

Applicants currently claim a process comprising (a) contacting a fuel stream containing organosulfur impurities with an organic hydroperoxide in the presence of an oxidation catalyst to form an oxidized fuel stream, wherein a substantial portion of the organosulfur impurities are converted into sulfones and a substantial portion of the organic hydroperoxide is converted into an alcohol; (b) removing the alcohol from the oxidized fuel stream to form an alcohol-reduced oxidized fuel stream; and (c) extracting the sulfones from the alcohol-reduced oxidized fuel stream by solid-liquid extraction using a sulfone adsorbent.

Louis teaches a process for desulfurizing a hydrocarbon. As in the currently claimed process, the Louis process comprises contacting the hydrocarbon with an oxidizing agent in the presence of a catalyst to oxidize the sulfur compounds, followed by removing the oxidized sulfur compounds by adsorption over a solid adsorbent. Like the presently claimed process, the hydrocarbon of Louis is taught to mainly be "chosen from petroleum fractions involved in the composition of any type of engine fuel and fuel. Mention may be made, among these, of kerosene, motor vehicle engine fuels, such as

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petrol or diesel, and domestic fuels, such as, for example, heating oil" (see para. 10 of equivalent U.S. 2006/000750). The oxidizing agent of Louis is taught to be gaseous oxygen, hydrogen peroxide, ozone, nitrogen oxides, nitric acid, organic peracids, inorganic peracids, chlorine, inorganic and organic hypochlorites, hydroperoxides, and persalts, although hydrogen peroxide is preferred. However, as Examiner notes, Louis does not teach the use of t-butyl hydroperoxide and, most importantly, Louis does not teach the removal of alcohol prior to the adsorption step.

Examiner points to Johnstone and Sorgenti to fill the gap.

Johnstone discloses that the oxidation of mercaptans with t-butyl hydroperoxide produces t-butyl alcohol. However, Johnstone describes that the oxidation produces alkyl disulfides rather than the sulfones produced by the currently claimed invention.

Sorgenti discloses an oxidation process to remove sulfur compounds, followed by the removal of sulfones. Sorgenti does not teach extracting sulfones from an oxidized fuel stream by solid-liquid extraction using a sulfone adsorbent, but rather discloses only high temperature reduction steps such as base treatment sulfur reducing step, a thermal treatment step, and a catalytic hydrodesulfurization step. In addition, Sorgenti discloses that t-butyl alcohol is produced as a decomposition product from t-butyl hydroperoxide.

Sorgenti also discloses that the t-butyl alcohol may be separated from the hydrocarbon material by distillation. However, the hydrocarbon material of Sorgenti is taught to be "heavy hydrocarbon materials such as petroleum fractions containing at least a major amount of material boiling above about 550°F, for example, crude oil and atmospheric and vacuum residues which contain about 1 percent by weight or more of sulfur. Additional examples of suitable hydrocarbon materials include cracked gas oils, residual fuel oils, topped or reduced crudes, crude petroleum from which the lighter fractions are absent, residues from cracking processes and sulfur-containing hydrocarbon materials from tar sands, oil shale and coal" (see Col. 7, l. 45-51).

Thus, the hydrocarbons of Sorgenti are not the same as those of Louis and the presently claimed invention. Whereas the presently claimed invention is a process for treating fuel streams (such as diesel fuel and gasoline), the hydrocarbon materials of

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Sorgenti are essentially the precursors of these fuel streams – crude oils and fractions that are much heavier than fuel streams.

Although Sorgenti teaches that the t-butyl alcohol may be recovered from the oxidized crude oil, the recovered t-butyl alcohol is taught by Sorgenti to be “used to improve the quality of unleaded gasoline” (see Col. 5, l. 55-58). Thus, Sorgenti suggests adding the recovered t-butyl alcohol to unleaded gasoline. Given that the hydrocarbon of Louis and that claimed in the current process are already fuel streams such as gasoline, one of ordinary skill in the art would not be motivated to remove the t-butyl alcohol from the fuel stream since it is taught by Sorgenti to be a fuel additive that improves the quality of gasoline. Instead, one would likely leave the t-butyl alcohol in the fuel stream as it is a known quality improver.

In sum, although it may be useful to remove t-butyl alcohol from the crude oils of Sorgenti prior to further processing to form fuels and other components from the crude oils, it would not be obvious to one of ordinary skill in the art to remove from a fuel stream what is taught to be a quality improver.

Lastly, there is nothing in the combination of Louis, Johnstone, and Sorgenti that suggests the unexpected result that performing the alcohol removal step prior to adsorption would improve the adsorption capacity of the solid adsorbents as demonstrated by Applicants (see the current Examples).

In sum, the prior art would not have suggested to those of ordinary skill in the art that they should carry out Applicants’ claimed process.

#### IV. Response to the Section 103(a) Rejection over Louis in view of Johnstone and Sorgenti, in further view of Herbstman

Applicants traverse the rejection of claims 3 and 4 under 35 U.S.C. § 103(a) as unpatentable over Louis et al. (WO 03/093203) in view of Johnstone (U.S. Pat. No. 2,593,761) and Sorgenti (U.S. Pat. No. 3,816,301), in further view of Herbstman et al. (U.S. Pat. No. 3,565,793) and they respectfully ask the Examiner to reconsider and withdraw the rejection in view of the following remarks.

The above argument also applies to the current rejection.

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In addition, Herbstman is too broad of a disclosure to suggest the use of a titanium-containing silicon oxide in the process of Louis, Sorgenti, or Johnstone. Herbstman teaches that the catalyst may be a Group IVB, VB, or VIB metal, of which titanium is only one of nine possibilities. Herbstman also teaches that the catalyst may be either homogeneous or heterogeneous. If heterogeneous, the Herbstman catalyst may be supported on silica, alumina, clays or carbons. Like Sorgenti, the preferred catalyst is a homogeneous molybdenum hexacarbonyl (see Col. 5, l. 72-75). In fact, the only catalysts taught in the Herbstman examples are either molybdenum or a vanadium catalysts, and the only heterogeneous catalysts use an alumina or clay support.

Thus, one of ordinary skill in the art would not be motivated to use a titanium-containing silicon oxide in the process of Louis, Sorgenti, or Johnston given the teaching of Herbstman.

In sum, the prior art would not have suggested to those of ordinary skill in the art that they should carry out Applicants' claimed process.

V. Response to the Section 103(a) Rejection over Louis in view of Herbstman, Johnstone, Sorgenti, and Whitehurst

Applicants traverse the rejection of claims 7-16 under 35 U.S.C. § 103(a) as unpatentable over Louis et al. (WO 03/093203) in view of Herbstman et al. (U.S. Pat. No. 3,565,793), Johnstone (U.S. Pat. No. 2,593,761), Sorgenti (U.S. Pat. No. 3,816,301), and Whitehurst et al. (U.S. Pat. No. 6,551,501), and they respectfully ask the Examiner to reconsider and withdraw the rejection in view of the following remarks.

The above arguments also apply to the current rejection.

In addition, although Whitehurst teaches a pretreatment step of treating diesel fuel with a selective adsorbent to remove polar materials, especially nitrogen containing compounds, the Whitehurst pretreatment step is taught as necessary step prior to a process for hydrotreating diesel fuels. Although Whitehurst teaches that removal of inhibiting polar materials from diesel fuel streams improves the hydrodesulfurization reaction, it does not teach, nor does it suggest, the removal of nitrogen containing

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compounds from fuel streams prior to oxidizing the organosulfur impurities by reaction with an organic hydroperoxide in the presence of a titanium-containing silicon oxide catalyst.

In fact, although Whitehurst describes that polar materials, especially nitrogen containing compounds, are detrimental to hydrodesulfurization catalysts, there is nothing in Whitehurst that suggests that organonitrogen compounds would be detrimental to the oxidation of organosulfur compounds in the presence of a titanium-containing silicon oxide catalyst or that their removal would be beneficial to the oxidation reaction. Thus, one of ordinary skill in the art would have no motivation to combine the teachings of Whitehurst which involve a pretreatment prior to a hydrodesulfurization process with the oxidation process of Louis, Sorgenti, Johnstone, or Herbstman.

Because of the inherent differences between hydrotreating and oxidation, it is improper to assume that a disclosure for the removal of polar materials prior to hydrotreatment suggests its use prior to oxidation. There is a significant difference between hydrotreatment and oxidation, for instance in the reactants, process temperature, pressure, catalysts, etc. Thus, given the inherent differences between hydrodesulfurization and oxidation, there is no suggestion in Louis, Sorgenti, Johnstone, Herbstman, and Whitehurst to modify the oxidation process of Louis, etc. with the nitrogen compound removal process useful in a hydrodesulfurization process that is taught in Whitehurst. In addition, one of ordinary skill in the art would have no reasonable expectation of success that a nitrogen removal step would lead to improved life of the titanium-containing silicon oxide catalyst by preventing the slow deterioration in performance associated with the presence of organonitrogen impurities as taught by Applicants in the present invention.

The mere fact that references can be combined or modified does not render the resultant combination obvious, unless the prior art also suggests the desirability of the combination. In this case, there is no suggestion or incentive to combine the cited prior art because the prior art does not teach the source of the problem.

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Specifically, Herbstman teaches at least 36 possible heterogeneous oxidation catalysts, not counting mixtures or homogeneous catalysts. As discussed above, Herbstman specifically lists that the catalysts can contain up to 9 different metals (the Group IVB, VB, or VIB metals) supported on a variety of supports (specifically listed oxides include silica, alumina, clays, or carbon). Yet, Herbstman does not disclose that any of these 36 possible oxidation catalysts may be detrimentally impacted by the presence of organonitrogen impurities in the fuel stream, let alone the titanium-containing silicon oxide catalyst required by Applicants' claimed process (claims 7-16). Therefore, Herbstman (as well as Louis, Sorgenti, Johnstone, and Whitehurst) is not a proper basis for an obviousness rejection since Herbstman, etc. does not teach the problem or its source.

Whitehurst on the other hand teaches a hydrotreating process that is completely different than the sulfur oxidation process of the currently claimed invention. There is nothing in Whitehurst that teaches or suggests that a titanium-containing silicon oxide catalyst would be detrimentally impacted by the presence of organonitrogen impurities in the fuel stream. Whitehurst does not teach: (a) titanium-containing silicon oxide catalysts, but rather teaches mixed cobalt and/or nickel and molybdenum sulphides supported on alumina and mixed nickel and tungsten sulphides supported on alumina or silica, or ruthenium sulfide; or (b) a sulfur oxidation process, but rather a hydrotreatment process.

Here, the discovery of the problem results in a patentable invention despite the fact that the solution may have been arguably obvious if the source of the problem was discovered. *Eibel Process Co. v. Minnesota & Ontario Paper Co.*, 261 U.S. 45 (1923). "A patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole' which should always be considered in determining the obviousness of an invention under 35 U.S.C. 103." *In re Peehs*, 612 F.2d 1287 (CCPA 1980). Where there is no evidence in the prior art that one of ordinary skill in the art would have expected a problem, it is not proper to conclude that an invention, which solves this problem, would have been obvious to a person of ordinary skill in the art.

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In fact, the current application, at page 7, l. 1-7, states that "when a titanium-containing silicon oxide catalyst is used in the oxidation step of the process, the titanium-containing silicon oxide catalyst tends to slowly deteriorate in performance when used repeatedly or in a continuous process. The deterioration appears to be associated with the presence of organonitrogen impurities in the fuel stream itself." Without this knowledge, there would be no incentive for one of ordinary skill in the art to seek a solution to an unknown problem. Applicants therefore respectfully suggest that Examiner has used impermissible hindsight to re-construct the claimed process from the prior art.

In sum, the prior art would not have suggested to those of ordinary skill in the art that they should carry out Applicants' claimed process.

In view of the foregoing, Applicants respectfully ask the Examiner to reconsider and withdraw the rejections and pass the case to issue. Applicants invite the Examiner to telephone their attorney at (610) 359-3480 if he believes that a discussion of the application might be helpful.

Respectfully submitted;

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